The Problem

In most circumstances, green building design principles strongly support efforts to reduce climate change. Site location and material selection goals seek to reduce transportation and manufacturing emissions. Building designs strive for minimal annual heating and cooling loads, and HVAC equipment is selected to maximize energy efficiency. In many green buildings, on-site renewable energy generation further reduces greenhouse gas production.

However, green building design includes a laudable goal that often *increases* greenhouse gas emissions: increase indoor air quality (IAQ). IAQ is typically improved through three methods: increased air filtration, increased ventilation air delivery rates, and reduced chemical off-gassing. Although careful material selection to reduce off-gassing should have no impact on the greenhouse gas emissions of green buildings, increased air filtration and ventilation airflow can have a substantial energy penalty.

The energy penalty associated with increased air filtration can be mostly mitigated through careful filter selection, frequent filter changeout, and pressure drop alarms. However, current HVAC product offerings are ill-equipped to deal with high ventilation air requirements (>20% of supply air), particularly in the hotter California climates where recent building activities have been concentrated. Ventilation air cooling loads can easily consume 50% of the HVAC system cooling capacity at design conditions.

Typical HVAC equipment, even in green buildings, uses refrigerant-based air-cooled vapor compression systems to provide cooling. Air-cooled vapor compression systems are a poor match for high ventilation airflow applications for three reasons. Firstly, they have their lowest capacity at design conditions. In most California climates, vapor compression systems operate at about 90% of their nameplate capacity at design conditions. Secondly, because vapor compression systems in high ventilation applications must set aside so much of their capacity to meet ventilation air cooling loads at peak conditions, they are grossly oversized for most operating hours, leading to short-cycling operating and efficiency problems. Finally, vapor compression systems have an efficiency ceiling of about 12.0 EER when used with an air-cooled condenser.

The Solution

Indirect evaporative cooling operates with maximum capacity and EER at design conditions, without adding moisture to the ventilation air stream. Indirect evaporative cooling equipment operates at EERs of 20-40 and can meet most, or all, of the ventilation air cooling load. In the preferred configuration, an indirect evaporative cooler handles the ventilation air load, with a vapor compression system handling the space cooling load. Such a system can be integrated into a single unitary product (including heating) or separate dedicated components in an engineered system.

Recent developments have brought several new indirect evaporative products to the market. These new systems have demonstrated higher efficiency levels than existing products, with similar or slightly higher costs. In addition, Davis Energy Group is developing a family of indirect evaporative heat exchangers that will match the performance of the latest products, with substantially lower costs. These heat exchangers will be used in dedicated ventilation air cooling products, as well as incorporated into a high-efficiency unitary rooftop HVAC product also currently under development at DEG. These efforts are being supported by the U.S. Department of Energy and California Energy Commission. **Incentives to support indirect evaporative systems for applications with high ventilation air requirements are critical to foster commercialization efforts of this product, and to ensure that no green building strategy results in increased greenhouse gas emissions.**